Smart Home Environmental Monitoring System

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Introduction

Introducing a cutting-edge smart home safety system that combines real-time monitoring with AI-driven automation. This project utilizes ubiquitous computing and machine learning to create a safer, more efficient home environment. The goal is to create a system that enhances home security by combining real-time monitoring with smart home automation

System Overview

1 Environmental Monitoring

Collect real-world data using the Sense Hat sensors on Raspberry Pi.

2 Machine Learning Integration

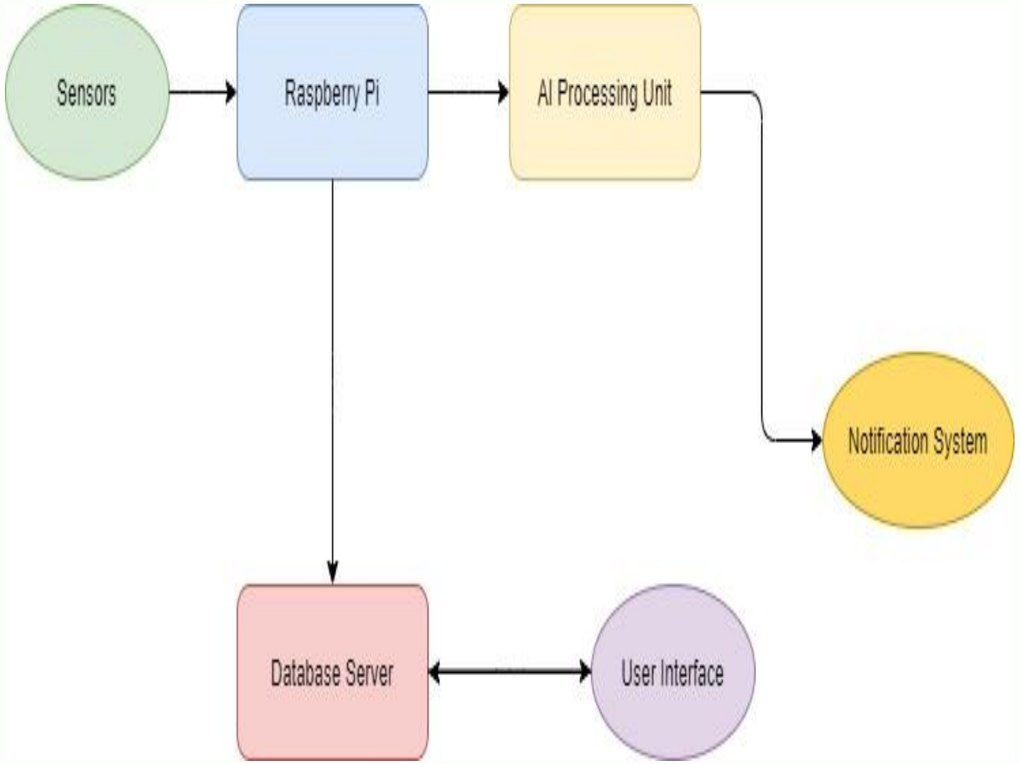
Use AI to adjust home conditions based on user's preferences.

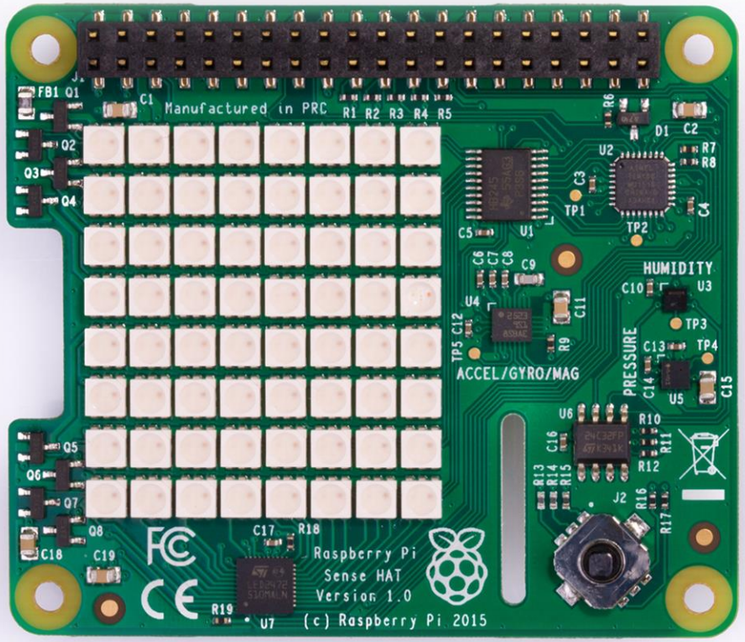
3 User Interface

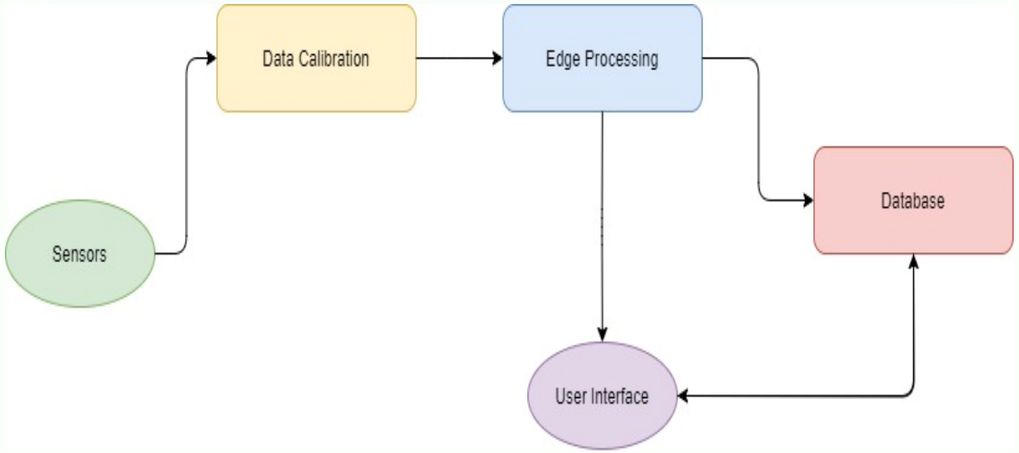
Web app displays data from the database and allows user interaction.

4 Alert System

Color-coded LED alerts and email notifications for safety hazards.







Sensor Integration

Temperature Sensor

Measures ambient temperature with recalibration to account for Raspberry Pi heat.

Humidity Sensor

Detects environmental humidity levels for optimal comfort and safety.

Pressure Sensor

Monitors atmospheric pressure for weather-related insights and predictions.

AI and Edge Computing

Random Forest Algorithm

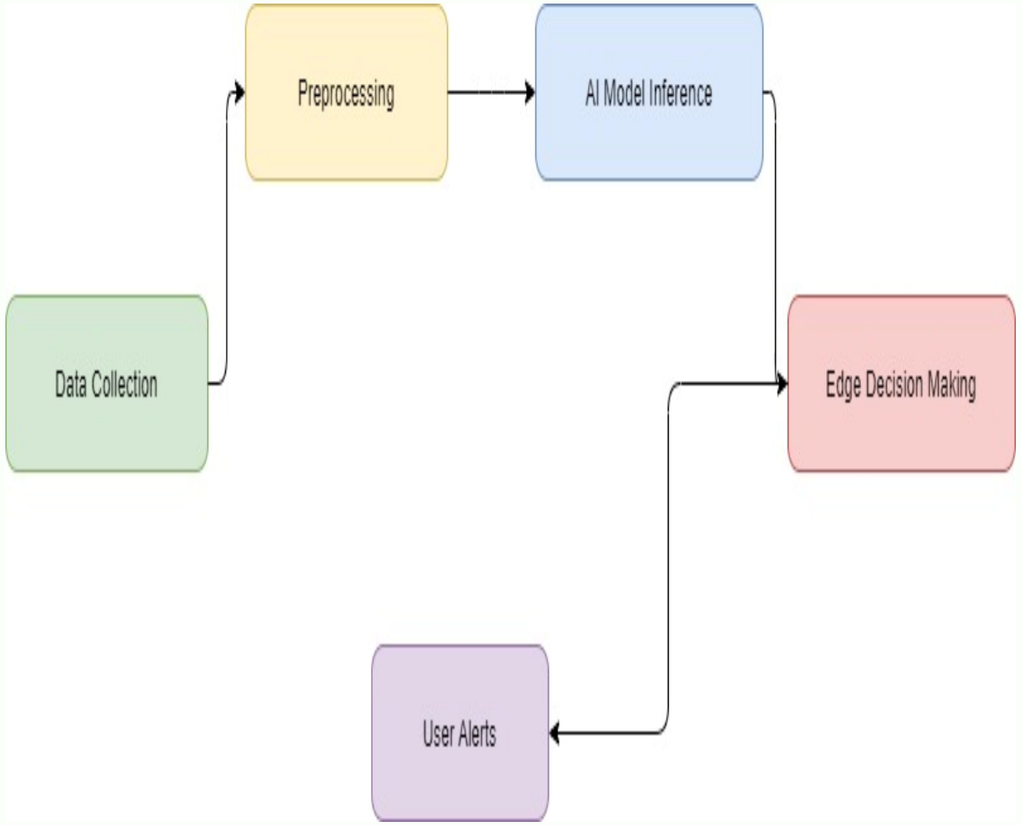
Predicts user preferences for temperature and light intensity based on historical data.

Edge Processing

Data processing on Raspberry Pi for real-time hazard detection and quick responses.

Optimization Strategies

Lightweight models and feature selection to meet computational limitations of Raspberry Pi.



Communication Architecture

1

Sensor Data Collection

Sense HAT sensors gather environmental data.

2

MQTT Protocol

Lightweight messaging protocol for IoT device communication.

3

Database Storage

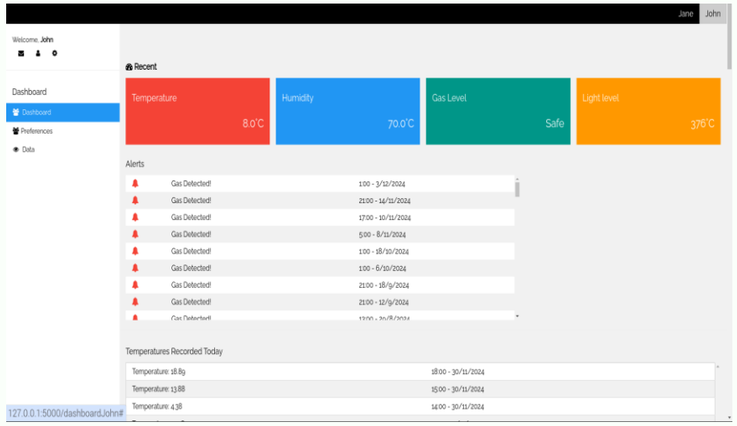
MySQL database stores sensor data and user preferences.

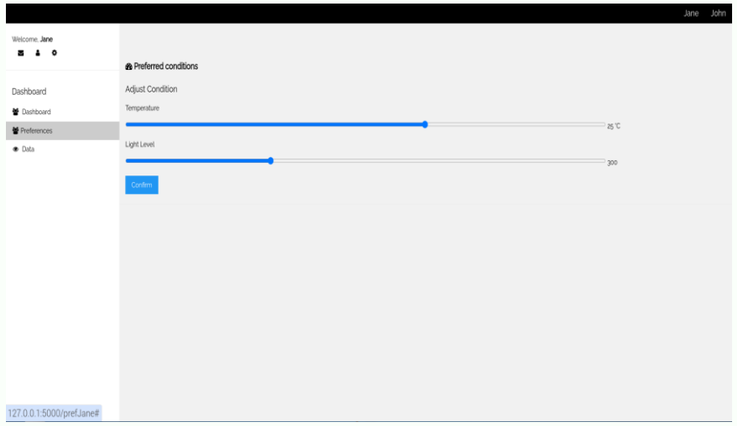
4

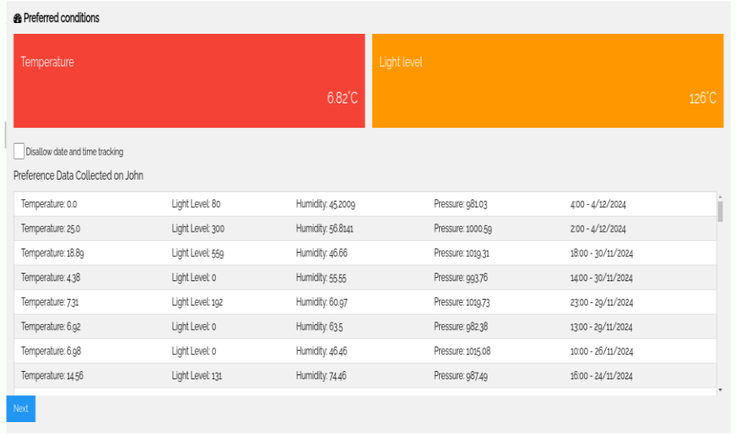
User Interface

Web dashboard displays real-time data and alerts.

User Interface Design







Dashboard

Displays current environmental conditions, historical trends, and recent hazard alerts.

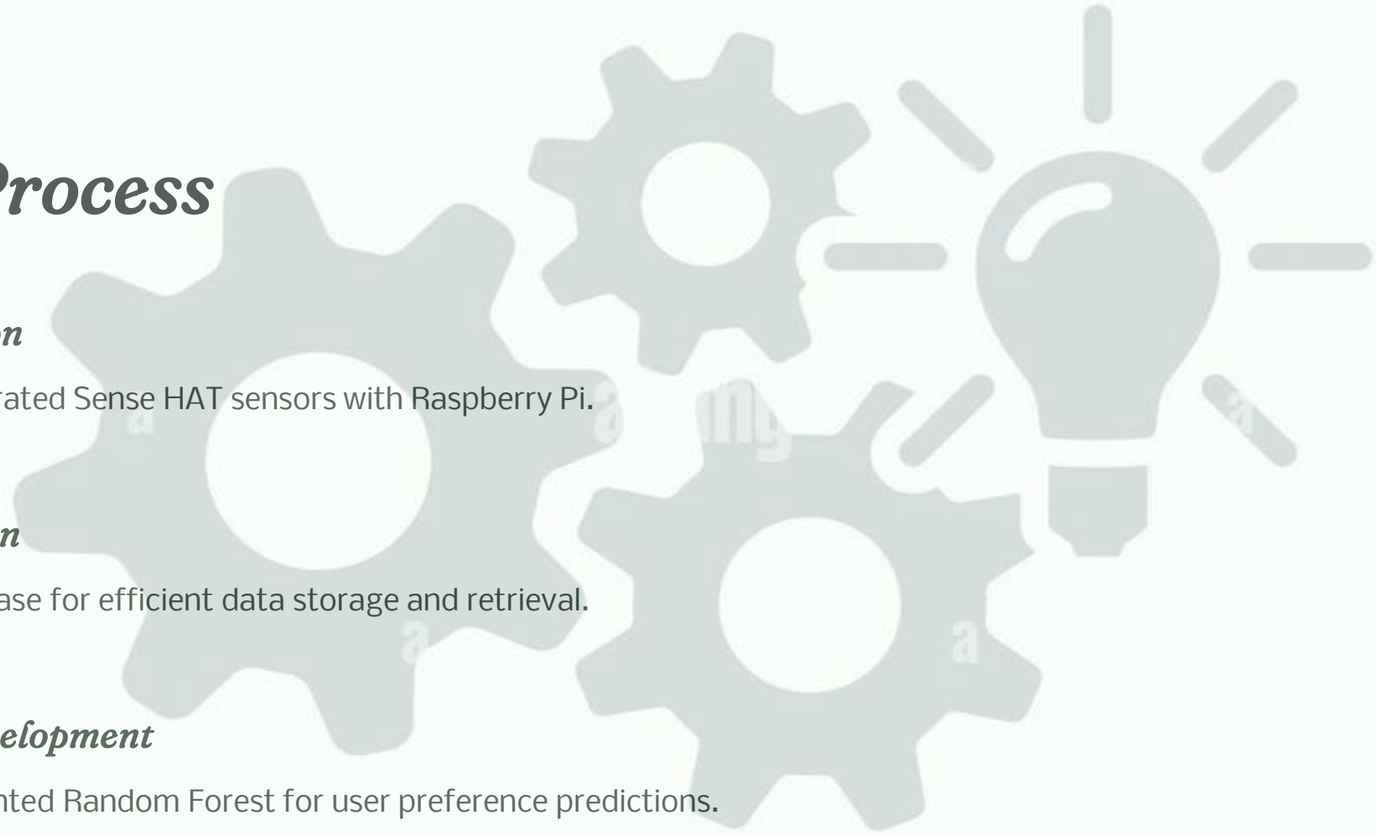
Preferences

Allows users to set temperature and light intensity preferences.

Data Management

Users can view and delete stored data, enhancing privacy control.

Development Process



1 **Sensor Integration**

Integrated and calibrated Sense HAT sensors with Raspberry Pi.

2 **Database Creation**

Set up MySQL database for efficient data storage and retrieval.

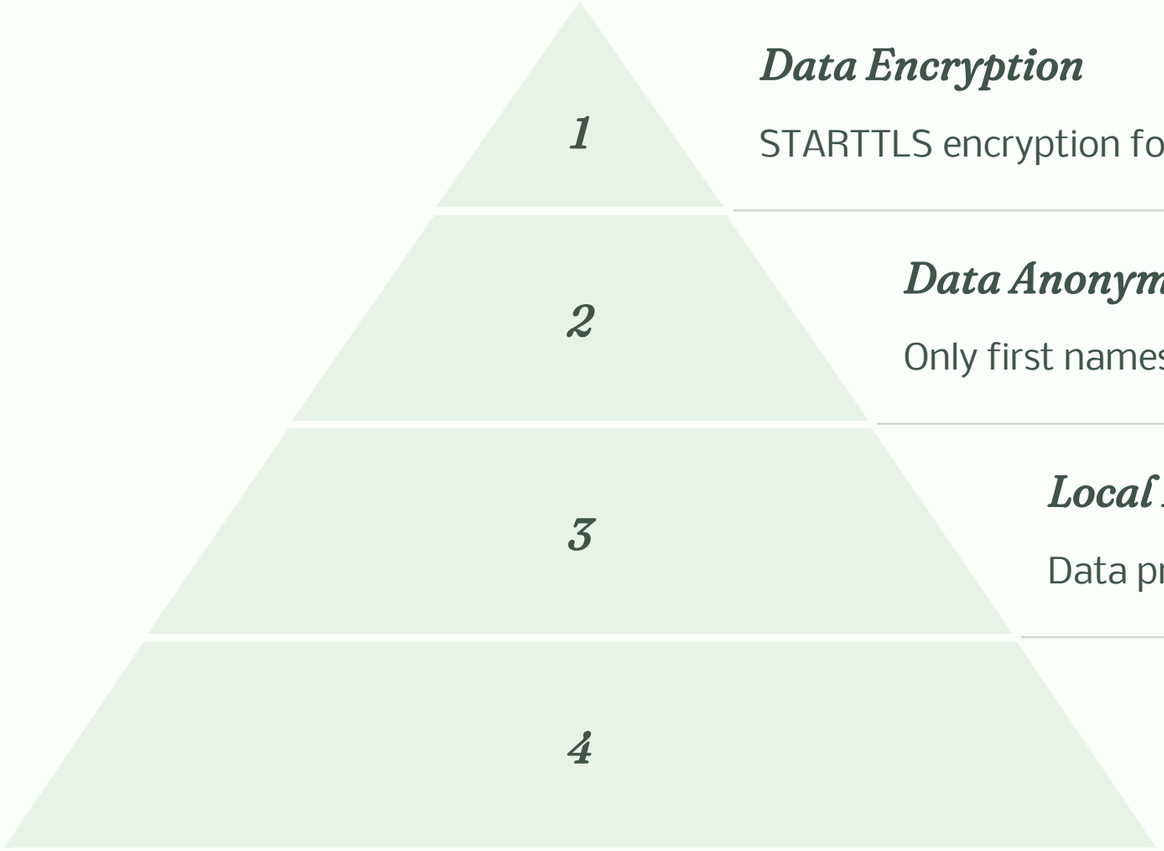
3 **AI Algorithm Development**

Tested and implemented Random Forest for user preference predictions.

4 **User Interface Development**

Created web dashboard for remote monitoring and user interaction.

Data Security and Privacy



Data Encryption

STARTTLS encryption for email alerts and TLS for MQTT communication.

Data Anonymization

Only first names stored, other identifying information removed.

Local Processing

Data processed on Raspberry Pi to minimize external network exposure.

User Control

Options to view, delete, and opt-out of data collection.

Legal Implications and Compliance

GDPR Compliance

System adheres to key GDPR principles including data minimization, transparency, and right to erasure.

Potential Liabilities

Measures in place to address risks of data breaches, false alerts, and system failures.

Societal Impact and Accessibility

Inclusive Design

Visual alerts and easy-to-navigate interface cater to diverse user needs.

Privacy Protection

Local data processing and user control over information collection.

Sustainability

Energy-efficient components and features to optimize home energy use.

Key Achievements and Future Improvements

1

Working Prototype

Successful integration of real-time monitoring, user adjustments, and hazard detection.

2

Machine Learning Model

Implemented Random Forest for predicting ideal temperature and light conditions.

3

User-Centric Design

Developed accessible web dashboard with privacy controls.

4

Future Enhancements

Addition of more sensors and integration with smart appliances.

Conclusion and Reflection

Technical Growth

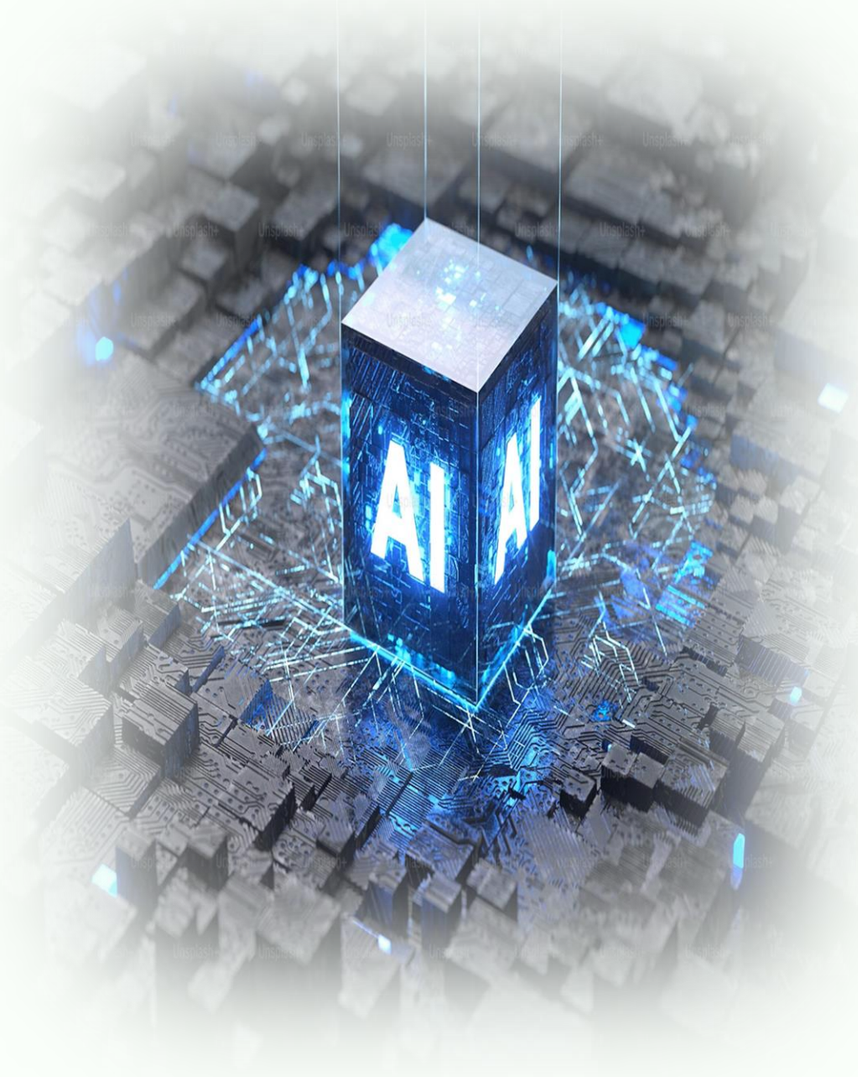
Gained insights into IoT, machine learning, and edge computing challenges.

Collaborative Problem-Solving

Strengthened teamwork skills in integrating hardware, software, and user interface design.

Ethical Considerations

Deepened understanding of responsible technology development and social impact.



THANK YOU

Any Questions?